BELL WORK
30-Jan-2014

How many grams of Magnesium Chloride are produced from the rxn between HCl and 4g of Mg? (hydrogen gas is also produced, write a balance equation first)

Agenda

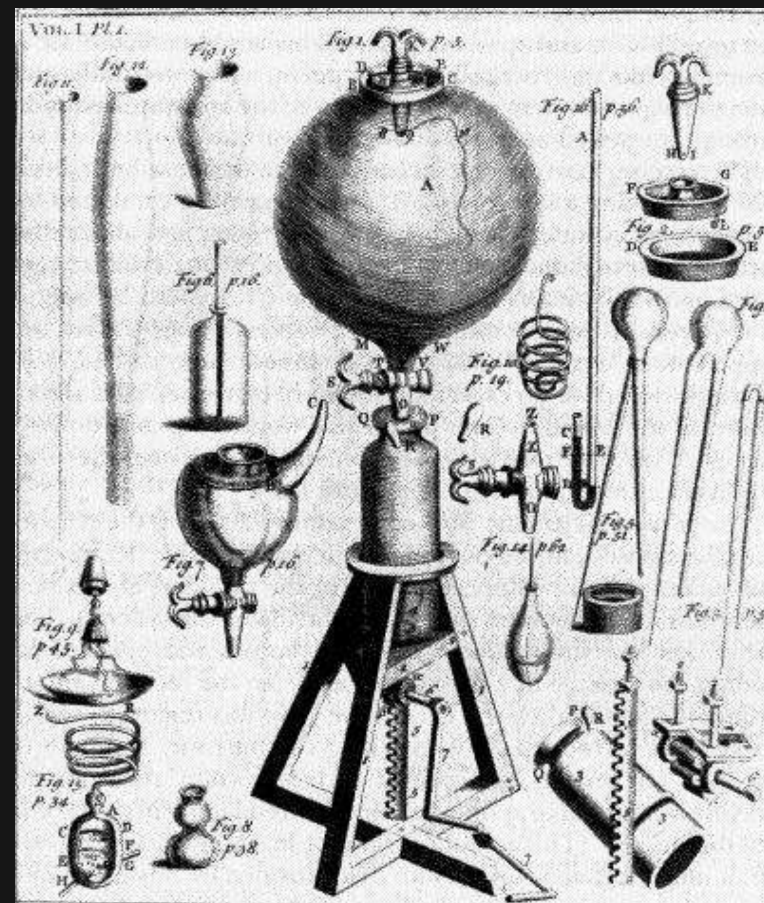
Boyle's Law lab

Objective:

You will understand the relationship between volume when changing pressure seperately

Boyle's Law Lab

Please do not damage the plunger/ syringe



Turn In
30 – Jan -2013

1. Limiting Reagents Sheets 1-3
2. Book Work: Page 456 #1-4

Bell Work
31-Jan-14

If a paint ball CO_2 tank is at a **pressure of 2000psi** and you know that **1psi** *equals* **51.7mmHg**, how many mmHg is that?

If the volume of the tank is 3.0L, and all of the gas transferred to a tank that is 1.25L, what is the new pressure in mmHg?

Agenda

Boyle’s Law

Objective:

You will understand the relationship between pressure and volume both mathematically and practically.

Pressure

Pressure = $\frac{\text{Force}}{\text{Area}}$

Units of Pressure

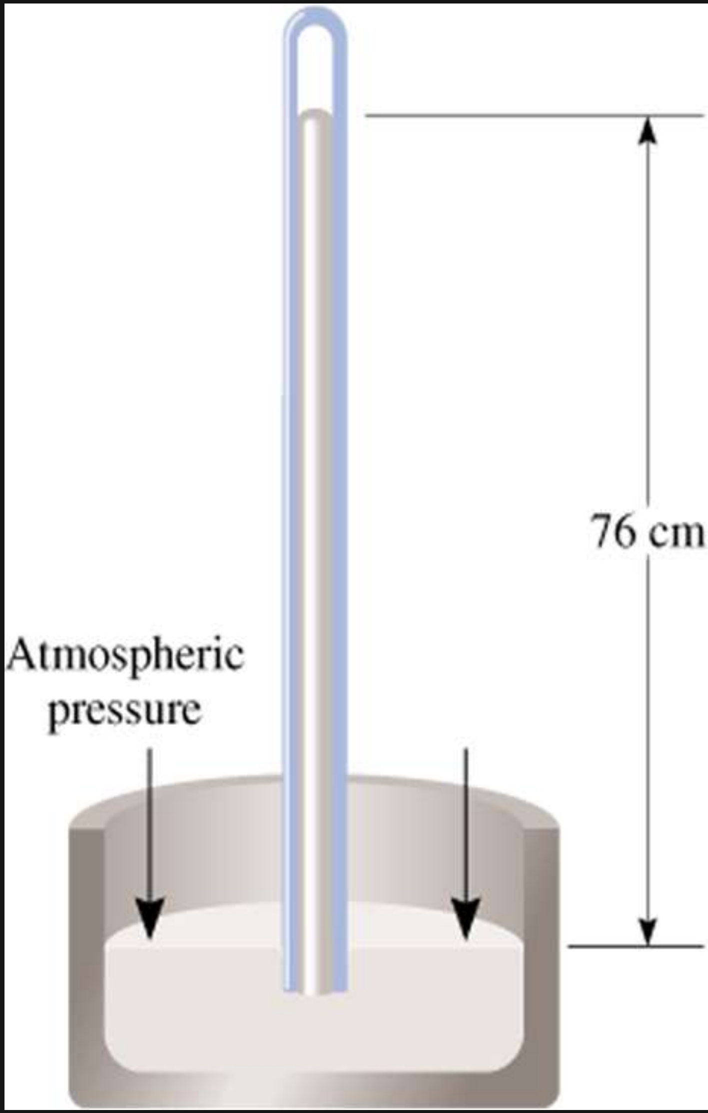
1 pascal (Pa) = 1 N/m^2

1atm =

760 mmHg

760 torr

101.325 kPa



Barometer

Try this…

Convert:

1. 727 mmHg into kPa

$$727\text{mmHg} \times \frac{101.325\text{kPa}}{760\text{mmHg}} = 96.9 \text{ kPa}$$

2. 52.5 kPa into atm
3. 0.729 atm into mmHg
4. 522 torr into kPa
5. 800.0 mmHg into atm
6. 495Pa into mmHg

Elements that exist as gases at 25^0C and 1 atmosphere

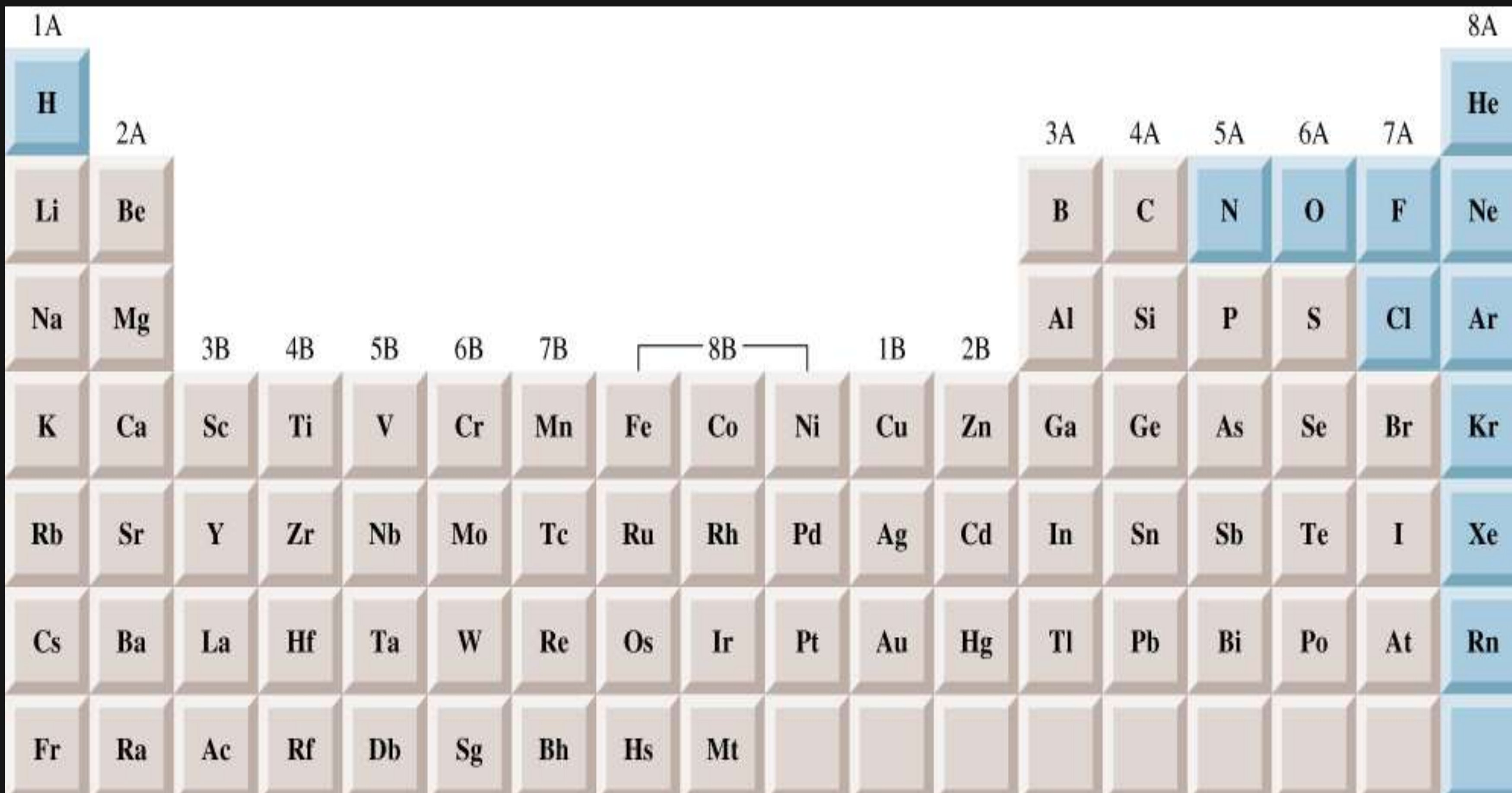


Table 5.1 Some Substances Found as Gases at 1 atm and 25°C

Elements	Compounds
H_2 (molecular hydrogen)	HF (hydrogen fluoride)
N_2 (molecular nitrogen)	HCl (hydrogen chloride)
O_2 (molecular oxygen)	HBr (hydrogen bromide)
O_3 (ozone)	HI (hydrogen iodide)
F_2 (molecular fluorine)	CO (carbon monoxide)
Cl_2 (molecular chlorine)	CO_2 (carbon dioxide)
He (helium)	NH_3 (ammonia)
Ne (neon)	NO (nitric oxide)
Ar (argon)	NO_2 (nitrogen dioxide)
Kr (krypton)	N_2O (nitrous oxide)
Xe (xenon)	SO_2 (sulfur dioxide)
Rn (radon)	H_2S (hydrogen sulfide)
	HCN (hydrogen cyanide)*

* *The boiling point of HCN is 26°C, but it is close enough to qualify as a gas at ordinary atmospheric conditions.*

Physical Characteristics of Gases

Gases assume the volume and shape of their containers.

Gases are the most compressible state of matter.

Gases will mix evenly and completely when confined to the same container.

Gases have much lower densities than liquids and solids.

$1dm^3$=1.0L

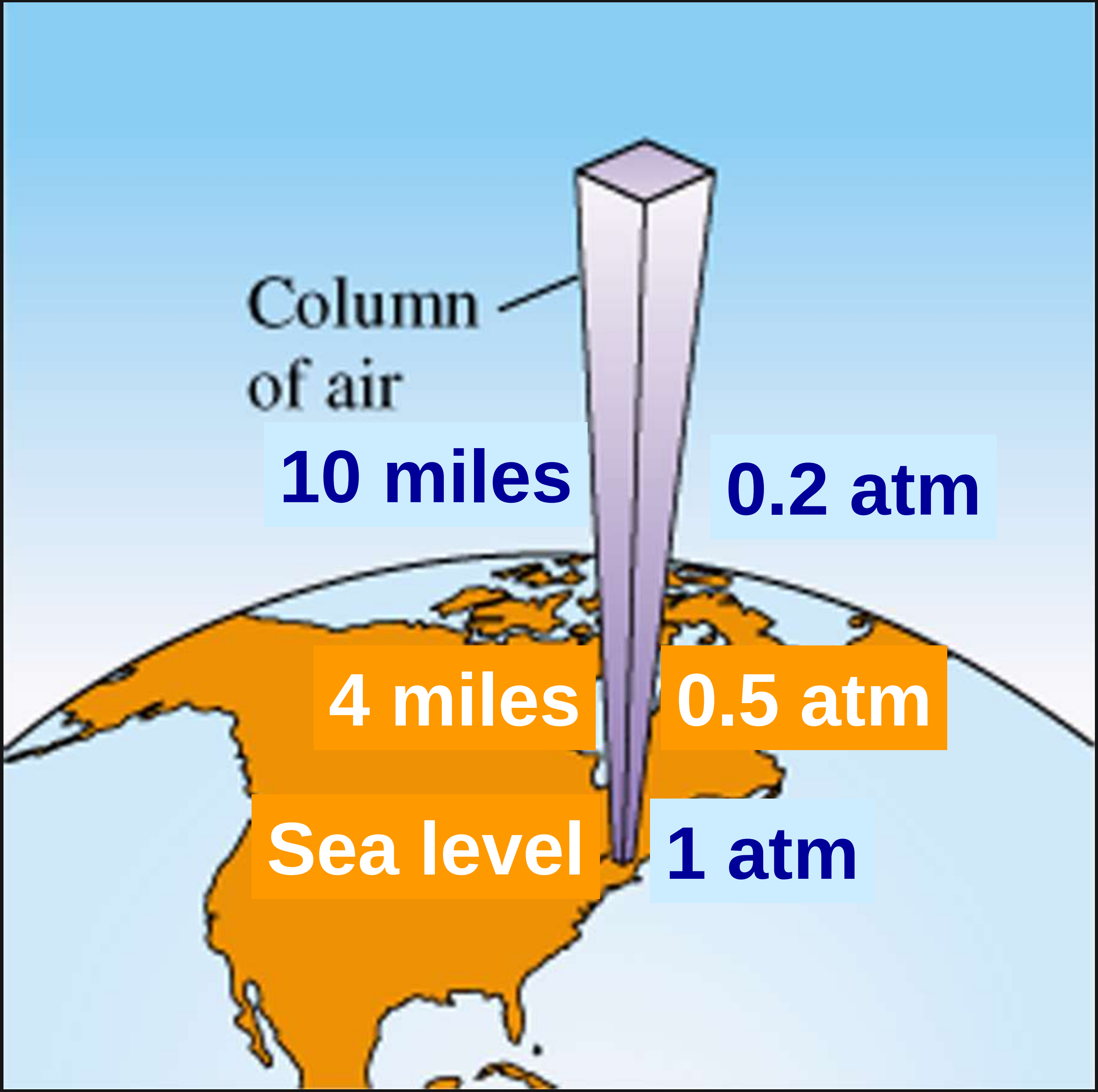
Standard Temperature and Pressure

Standard temperature and pressure, abbreviated **STP**, refers to nominal conditions in the atmosphere at sea level. This value is important to physicists, chemists, engineers, and pilots and navigators.

Temperature = 0° C or 273K

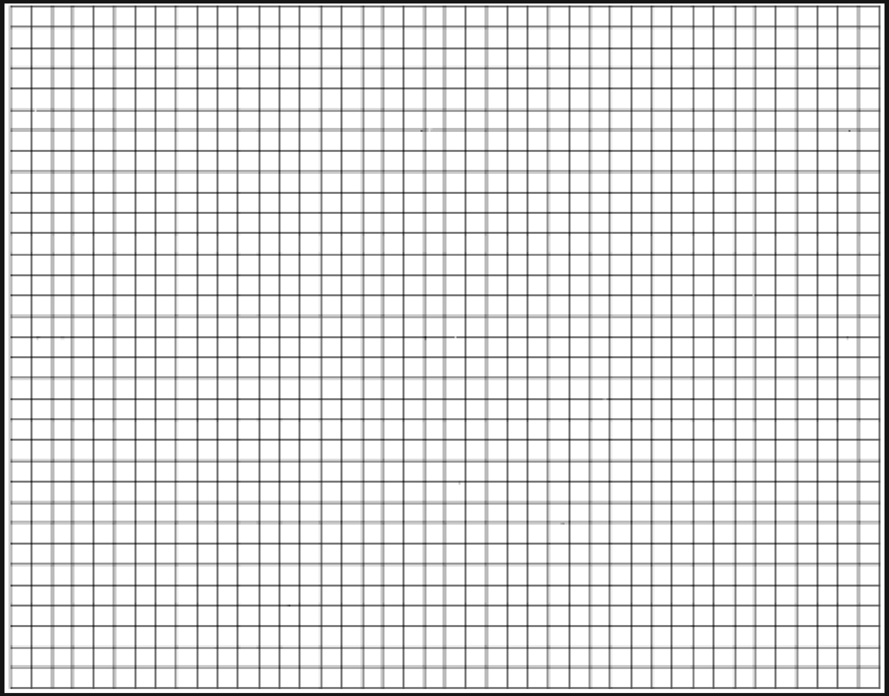
Pressure = 1atm

This is essentially the freezing point of pure water at sea level, in air at standard pressure

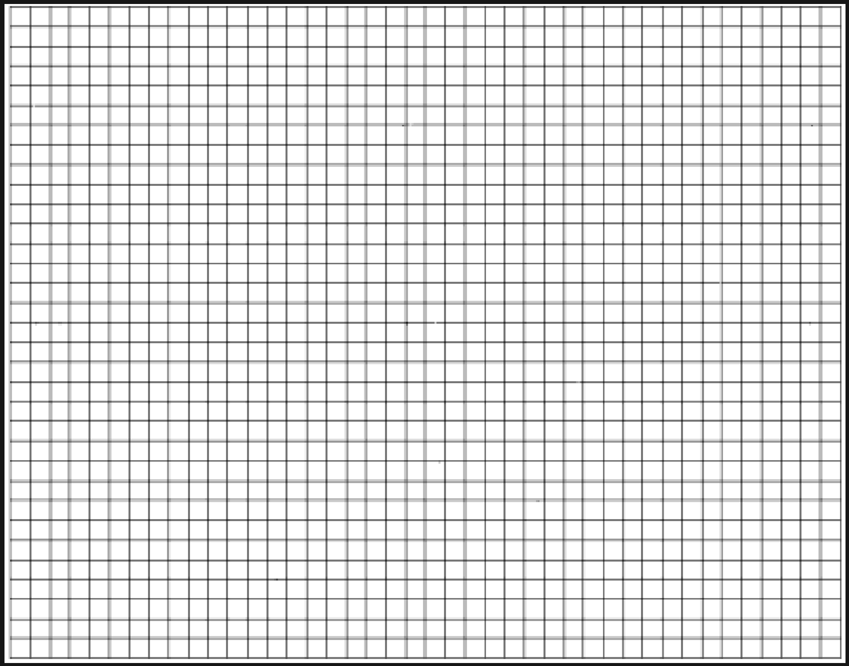

Column of air
10 miles
0.2 atm
4 miles
0.5 atm
Sea level
1 atm

Boyle's Law Lab

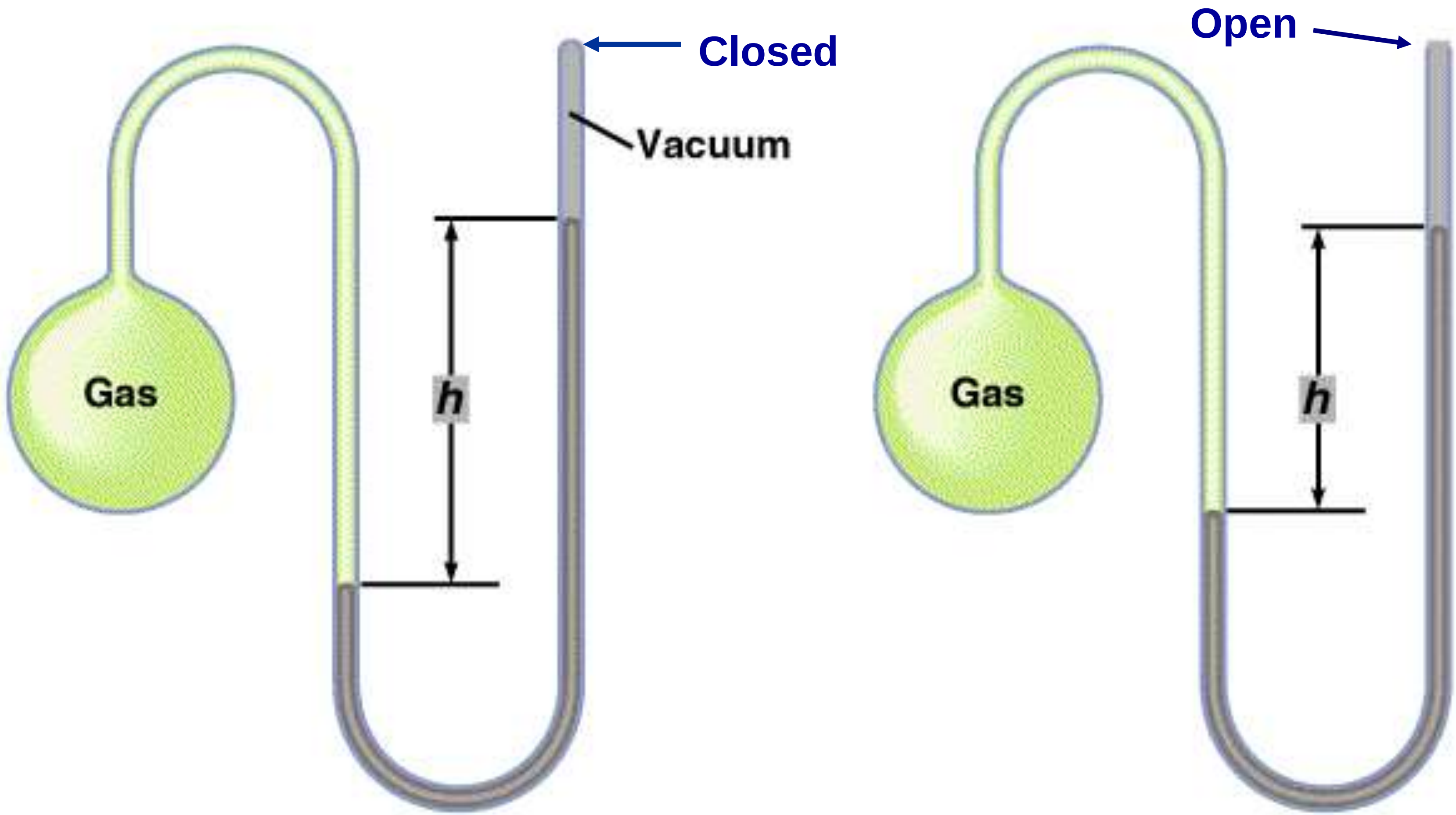
Book vs. V



P_T vs. 1/V



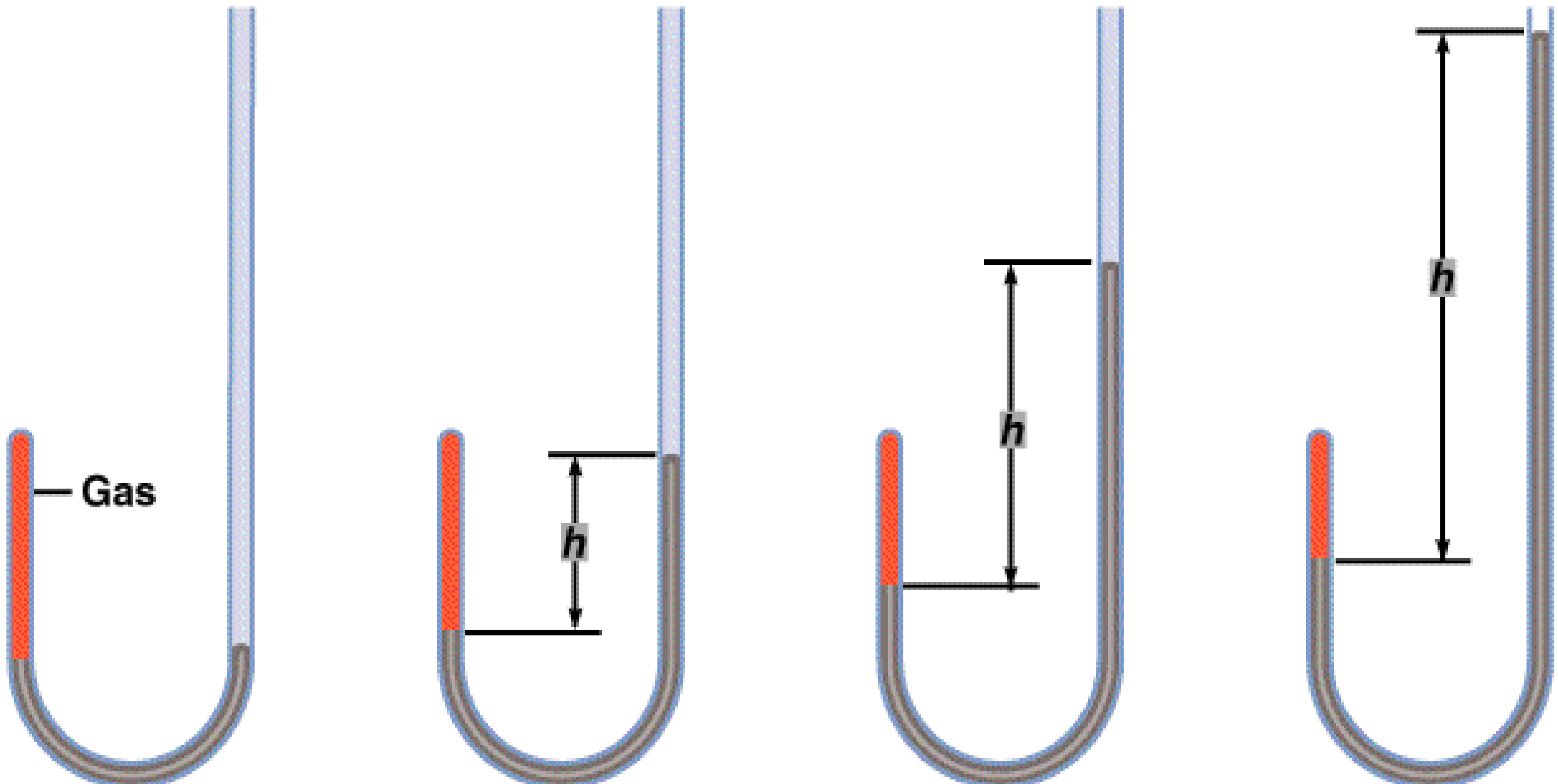
Manometers Used to Measure Gas Pressures



$P_{gas} = P_h$

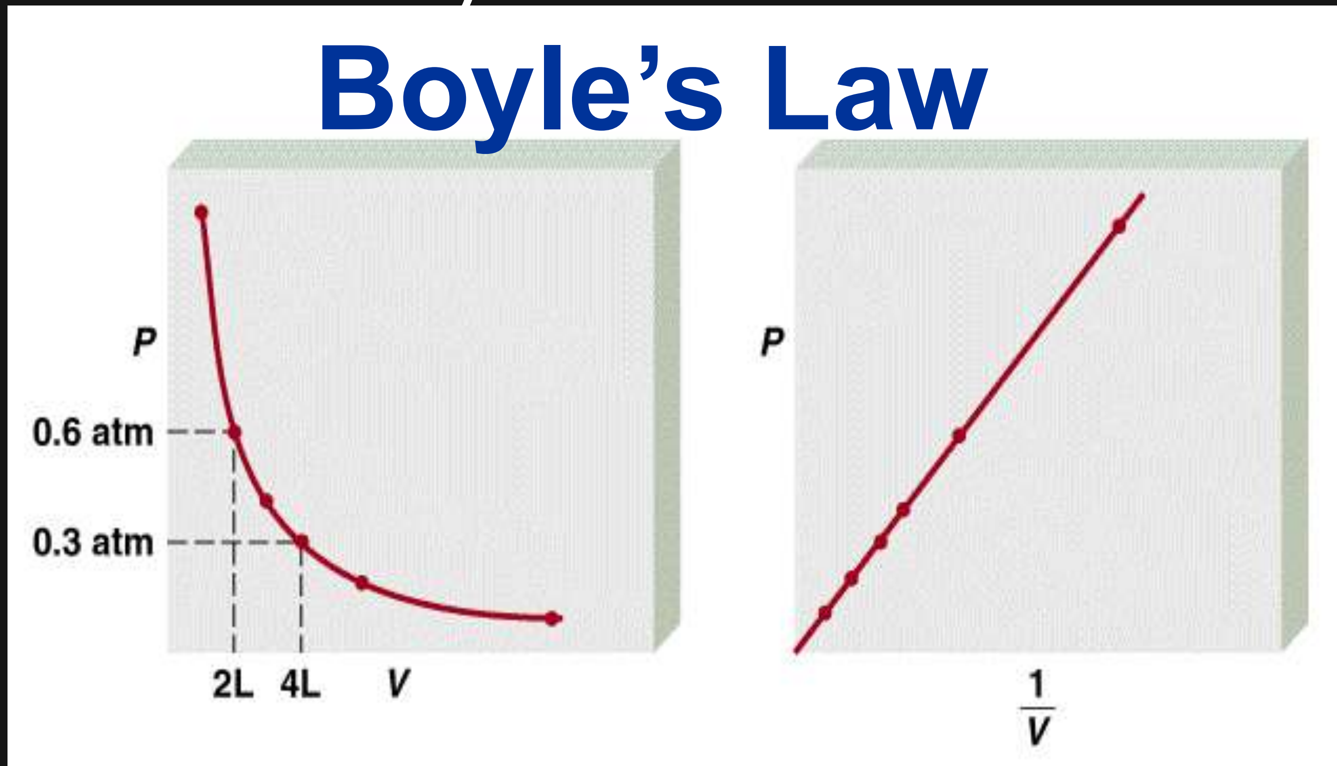
$P_{gas} = P_h + P_{atm}$

Apparatus for Studying the Relationship between Pressure and Volume of a Gas



As *P* (h) increases   *V* decreases

Boyle's Law



$P \propto 1/V$

Constant temp. Const. amount of gas

$P \times V$ = constant

$$P_1 \times V_1 = P_2 \times V_2$$

What is Boyles Law…

$P_1V_1 = P_2V_2$

So pressure is inversely proportional to volume:

As Pressure goes up… volume goes____

As pressure goes down… volume goes_____

Try this…

A sample of chlorine gas occupies a volume of 946mL at a pressure of 726mmHg. What is the pressure of the gas (in mmHg) if the volume is reduced at constant temperature to 154 mL?

A sample of chlorine gas occupies a volume of 946 mL at a pressure of 726 mmHg. What is the pressure of the gas (in mmHg) if the volume is reduced at constant temperature to 154 mL?

$$P_1 \times V_1 = P_2 \times V_2$$

P_1 = 726 mmHg $\quad$ P_2 = ?

V_1 = 946 mL $\quad$ V_2 = 154 mL

$$P_2 = \frac{P_1 \times V_1}{V_2} = \frac{726 \text{ mmHg} \times 946 \text{ mL}}{154 \text{ mL}}$$

= 4460 mmHg

From the data in the following table calculate the missing quantity (assuming constant temperature).

a) V_1 = 22.4 L; P_1= 1 atm; P_2 =? atm; V_2 = 2.8L

b) V_1 = 60mL; P_1 =? kPa; P_2 = 101.3kPa; V_2= 16 mL

c) V_1 = ? L ; P_1 = 40 Pa; P_2 = 100 kPa; V_2 = 1.0 L

d) V_1 = 2.50 L; P_1 = 7.5 atm; P_2 = ?atm; V_2 = 100mL

Practice makes perfect ☺

A sample of hydrogen at 1.50 atm had its pressure decreased to 0.50 atm producing a new volume of 750 mL. What was the sample's original volume?

250ml

Fluorine gas exerts a pressure of 900 torr. When the pressure is changed to 1.50 atm, its volume is 250 mL. What was the original volume?

317ml

Turn In
31 – Jan -2013

1. Boyles Law Lab
2. BW #2.3

Home Work
31-Jan-2013

Complete B and C Gas Law Practice

#2-7, 10, 13, and 14 on a separate sheet of paper showing all work.

Bell Work, New BW #2.3 3-Feb-2014

What would you expect the volume of a balloon to be if you decrease the pressure by half?

We will turn in BW #2.2 at end of Bell Work

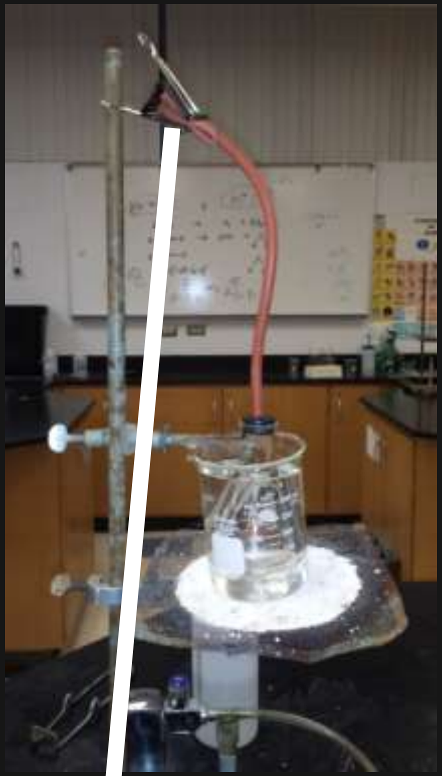
Agenda

Charle's Law

Objective:

You will Discover how volume is related to temperature

Charles Law and Water



When do I clamp?

Bring ~ 200-225ml of water to a light boil.

Make sure rubber tubing does not come in contact with flame.

If the rubber stopper and the clamp do not make a perfect seal, you lab will not perform.

Use 1-2 hand full of ice to make an ice water bath for sep 6

Science Fair, Poster Board Tags

Attach name slip per instructions on the right panel when closed as it faces you

Bell Work
4-Feb-2014

The highest pressure ever produced in a laboratory setting was about 2.0 x 10^6atm. If we have a 1.0 x 10^{-5} L sample of a gas at that pressure, then release the pressure until it is equal to 0.275atm, what would the new volume of that gas be?

Charles Law Lab

V vs T

$$\% \text{ Error} = \frac{|\text{Experimental} - \text{Theoretical}|}{|\text{Theoretical}|} \times 100$$

Charles Law lab Skip

Immediately start heating 500-600mL of water in a 1 000mL beaker on your hot plate. Unplug plate when not in use.

Try to test at least 5 different water temps

All temperature must be converted to Kelvin

To convert $^0C \rightarrow K$

$T (K) = t (^0C) + 273$

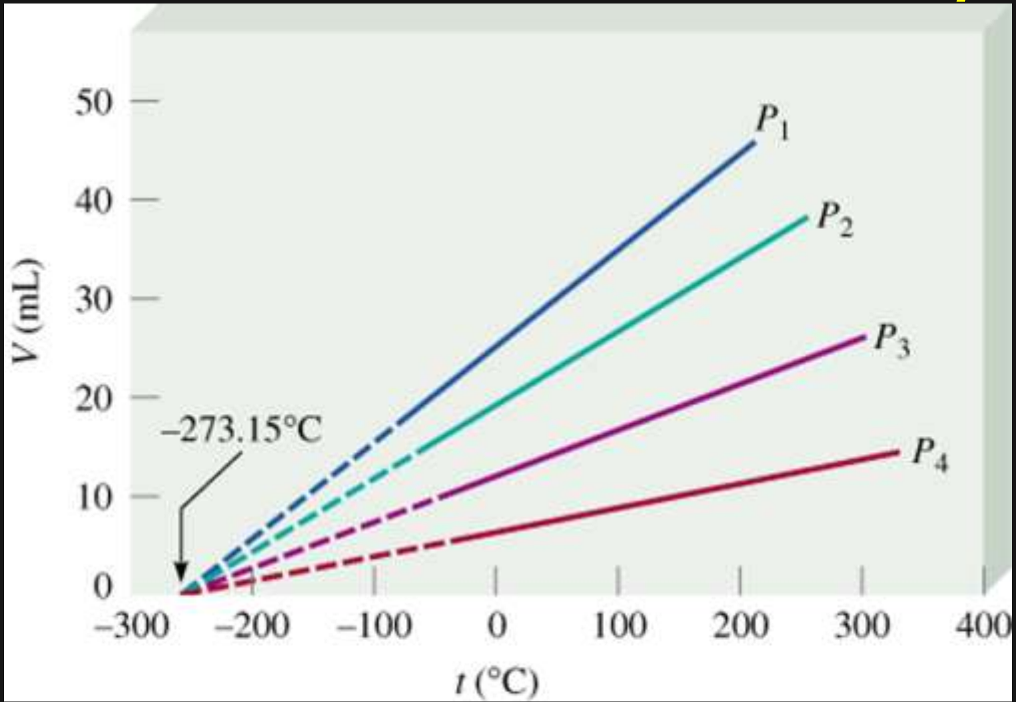
To convert $K \rightarrow {^0C}$

$T (^0C) = t (K) - 273$

Why is the Kelvin scale used exclusively in gas law calculations?

Because there are no negative temperature

Variation of gas volume with temp. at constant pressure.

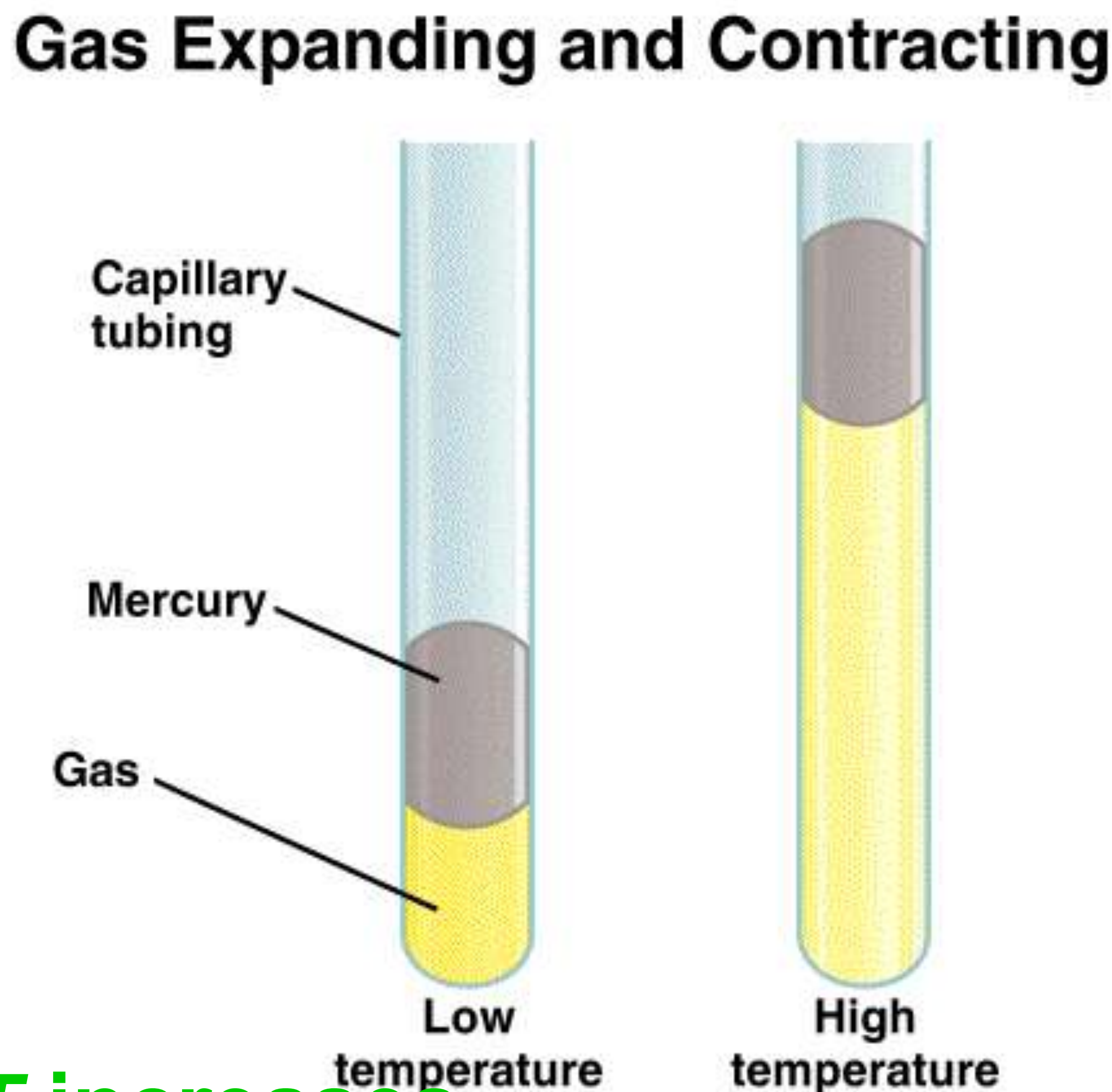


Charles' & Gay-Lussac's Law

$$V \alpha T$$

$$V = \text{constant} \times T$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$



As *T* increases…

V increases

Word Problem Solving Box

1. What you want?	
2. Given Information	4. Plan
	5. Calculations for solutions
3. Useful formulas/ conversions	

Try this…

A sample of carbon monoxide gas occupies 3.20 L at 125 ^{0}C. At what temperature will the gas occupy a volume of 1.54 L if the pressure remains constant?

A sample of carbon monoxide gas occupies 3.20 L at 125 ^{0}C. At what temperature will the gas occupy a volume of 1.54 L if the pressure remains constant?

1. What you want? $T_2 = ?$	
2. Given Information $V_1 = 3.20$ L $V_2 = 1.54$ L $T_1 = 398$ K	4. Plan *Solve for* T_2
3. Useful formulas/ conversions $V_1/T_1 = V_2/T_2$ $T_2 = \frac{V_2 \times T_1}{V_1}$	5. Calculations for solutions $= \frac{1.54 \text{ L} \times 398 \text{ K}}{3.20 \text{ L}}$ **= 192 K**

Fist Six Gas law Formulas

Boyles law

$$P_1 \times V_1 = P_2 \times V_2$$

Charles law

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

Dalton Law of Partial Pressure

$$P_{total} = \Sigma P_n$$

$$= P_1 + P_2 \ldots + P_n$$

Avogadro's law

$$\frac{V_1}{n_1} = \frac{V_2}{n_2}$$

Gay-Lussac's Law

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

Combined Gas Law

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

Home Work
4-Feb-2013

Complete B and C Gas Law Practice

#1, 8, 9, 11 and 12 on a separate sheet of paper showing all work using Word Problem Solving Box.

The remained of the problems will be turned in this Thursday, 6 Feb 2014

Bell Work
5-Feb-2014

A. Deep sea divers have to use a mixture of gases at depth in order to avoid sickness. If a tank contains 1.60atm of O_2, 0.5atm of He and 2.9atm of N_2, what is the total pressure of the tank?

B. If the diver consumes 0.25g of oxygen by rxn with $C_6H_{12}O_6$ for each breath, what mass of CO_2 is exhaled?
What is the vol. of CO_2 in L (22.4L/mol)?

Agenda

Kinetic Molecular Theory

Daltons law of Partial Pressure

Avogadro's Law

Objective

By the end of the period you will be able to use the combined gas law to give a basic explanation on the relationship between, Pressure, Volume, and Temp, with an ideal gas and perform strait forward calculations.

Practice makes perfect ☺

1.00 L of a gas at standard temperature and pressure is compressed to 473 mL. What is the new pressure of the gas?

2.11atm

In a thermonuclear device, the pressure of 0.050 liters of gas within the bomb casing reaches 4.0×10^6 atm. When the bomb casing is destroyed by the explosion, the gas is released into the atmosphere where it reaches a pressure of 1.00 atm. What is the volume of the gas after the explosion? 2.0×10^5 L

Practice makes perfect ☺

Synthetic diamonds can be manufactured at pressures of 6.00×10^4atm. If we took 2.00 L of gas at 1.00atm and compressed it to a pressure of 6.00×10^4atm, what would the volume of that gas be?

Recall…

With your partner convert 23 015Pa to atm

According to Boyle's Law what happens to Pressure as volume increases?

Kinetic Molecular Theory of Gases

1. A gas is composed of molecules that are separated from each other by distances far greater than their own dimensions. The molecules can be considered to be *points*; that is, they possess mass but have negligible vol.

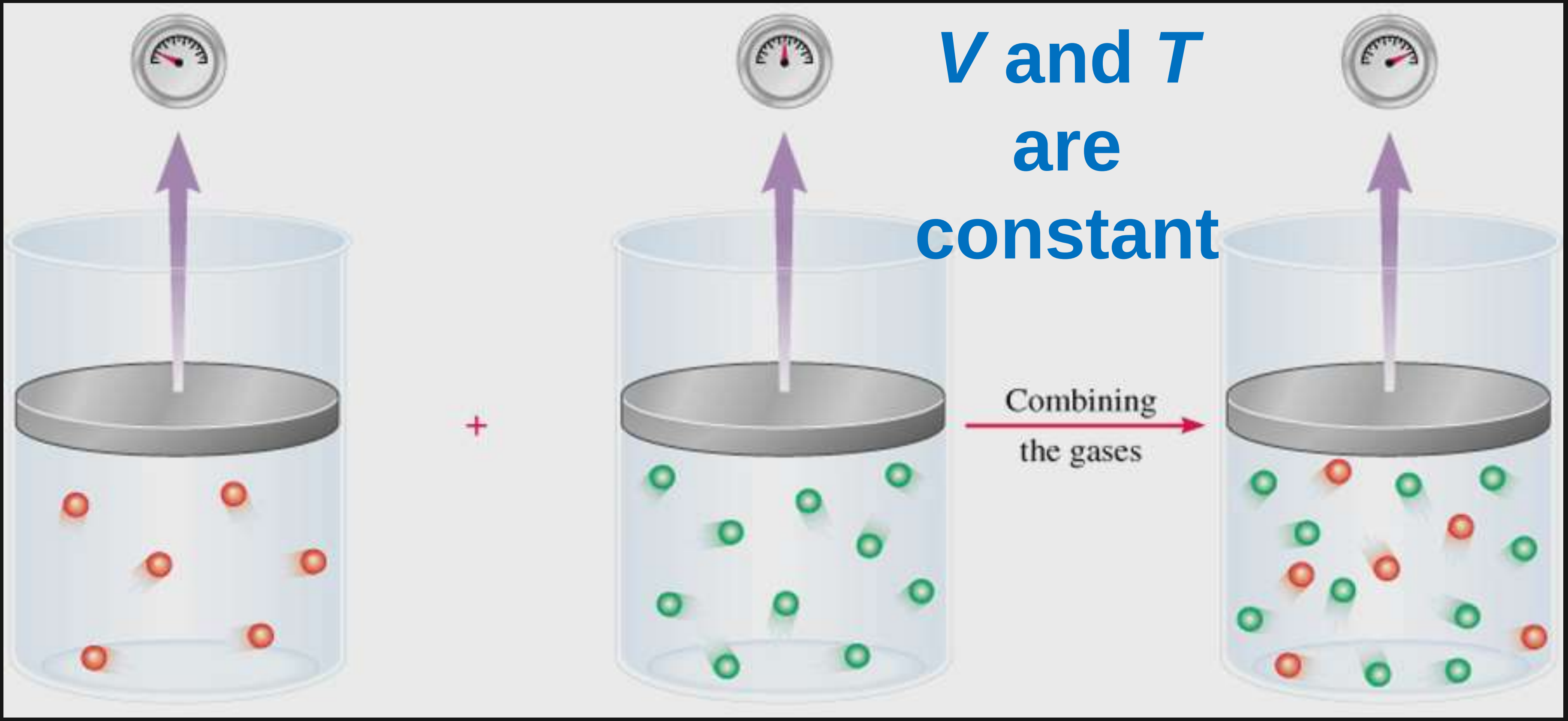
2. Gas molecules are in constant motion in random directions. Collisions among molecules are perfectly elastic.

Kinetic Molecular Theory of Gases

3. Gas exert neither attractive nor repulsive forces on one another.

4. The average kinetic energy of the molecules is proportional to the temperature of the gas in kelvins. Any two gases at the same temperature will have the same average kinetic energy

Dalton's Law of Partial Pressures



P_1 P_2 $P_{total} = P_1 + P_2$

Dalton's Law of Partial Pressures

So the total pressure exerted by a mixture of gases in a container at constant V and T is equal to the sum of the partial pressure of each individual gas in the container, a statement known as Dalton's law of partial pressure

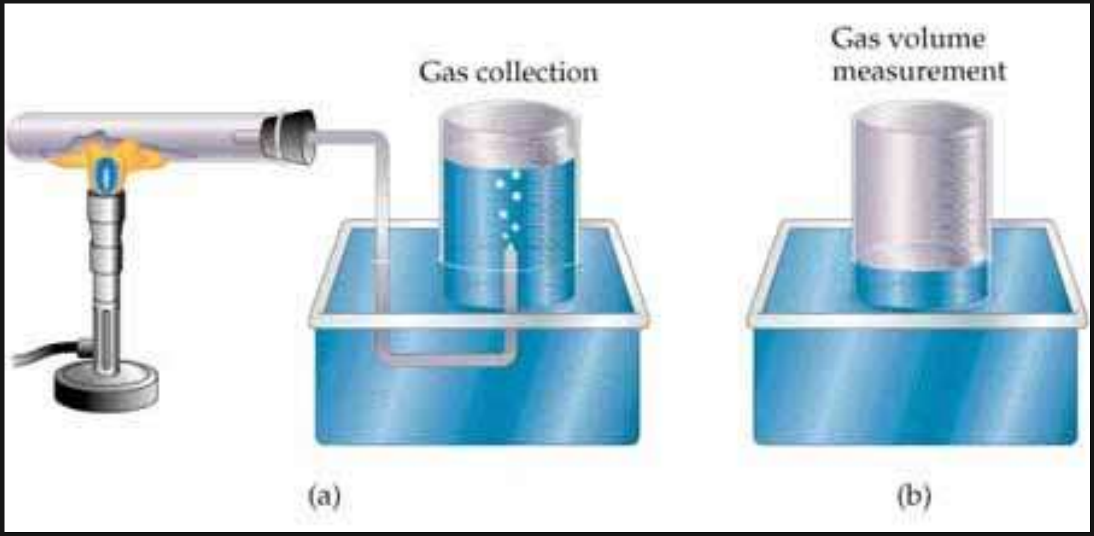
$$P_{tot} = P_1 + P_2 + P_3 \ldots \text{at constant V and T}$$

Where P_1, P_2, P_3 …. refer to the pressure each individual gas would have if it were alone.

Dalton's Law of Partial Pressures

A common method of gas collection in the laboratory involves displacing water from a bottle, so that you know when the bottle is full of an invisible gas.

The gas that is left in the bottle will not be pure, it will be a mixture that contains a certain amount of water vapor.

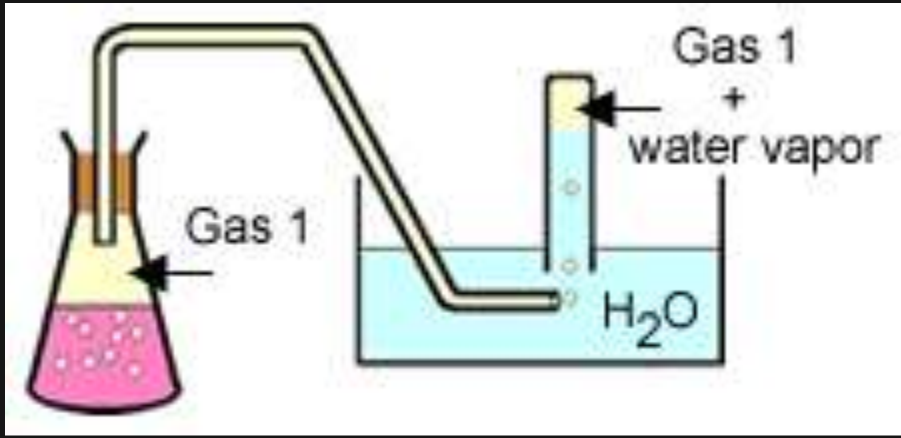


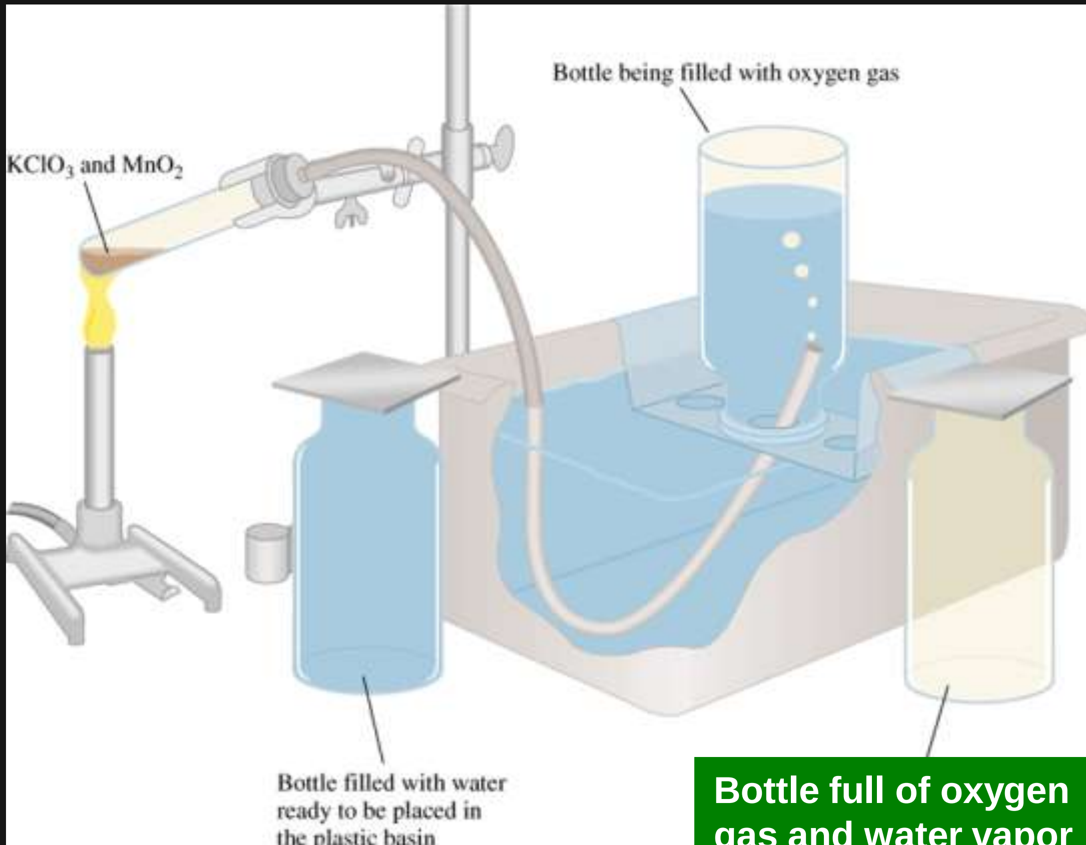
Dalton's Law of Partial Pressures

When collecting a gas over water you need to account for the "Vapor pressure" of water at the collection temperature.

To find the pressure of the dry gas alone, we need to subtract out the pressure of the water vapor.

$$P_{\text{dry gas}} = P_{\text{total}} - P_{\text{water vapor}}$$





Bottle full of oxygen gas and water vapor

$$2KClO_3\ (s) \rightarrow 2KCl\ (s) + 3O_2\ (g)$$

$$P_T = P_{O_2} + P_{H_2O}$$

Table 5.3 Pressure of Water Vapor at Various Temperatures

Temperature (°C)	Water Vapor Pressure (mmHg)
0	4.58
5	6.54
10	9.21
15	12.79
20	17.54
25	23.76
30	31.82
35	42.18
40	55.32
45	71.88
50	92.51
55	118.04
60	149.38
65	187.54
70	233.7
75	289.1
80	355.1
85	433.6
90	525.76
95	633.90
100	760.00

Dalton's Law of Partial Pressures

A sample of H_2 gas is collected over water at 14.0^{o}C, vapor pressure of H_20 at 14^{o}C is1.6kPa. The pressure of the resultant mixture is 113.0kPa. What is the pressure that is exerted by the dry H_2 alone?

$P_{dry\ gas} = P_{total} - P_{water\ vapor}$

$P_{dry\ gas} = ?$

$P_{total} = 113.0\ kPa$

$P_{water\ vapor} = 1.6\ kPa$

$P_{H2} = 113.0\ kPa - 1.6\ kPa$

$P_{H2} = 111.4\ kPa$

Practice makes perfect ☺

A sample of nitrogen occupies a volume of 250 mL at 25 °C. What volume will it occupy at 95 °C?

308.7ml

Helium occupies a volume of 3.80 Liters at – 45 °C. What volume will it occupy at 45 °C?

5.3L

A 175 mL sample of neon had its pressure changed from 75.0 kPa to 150 kPa. What is its new volume (its not Charles Law)?

87.5ml

Practice makes perfect ☺

A sample of gas has an initial volume of 25 L and an initial pressure of 3.5 atm. If the pressure changes to 1.3 atm, find the new volume, assuming that the temperature remains constant.

A sample of neon is at 89^oC and 123 kPa. If the pressure changes to 145 kPa and the volume remains constant, find the new temperature, in ^oC.

Practice makes perfect ☺

A sample of neon has a volume of 1.83 L at 23.5^{o}C. At what temperature would the gas occupy 5.00 L? Assume pressure is constant.

A sample of argon is collected in a $5.00x10^{2}cm^{3}$ bottle at a temp. of 12.0^{o}C. Assuming the pressure remains the same, what volume would the gas occupy at 2.0 ^{o}C?

Answer w/ your partner

Consider the following changes imposed upon a sample of gas, assuming the variables not mentioned remain constant:

a. What happens to the pressure if the temperature in K is doubled?

b. What happens to the volume if the pressure is tripled?

c. What happens to the volume if the temperature decreases from 300K to 200K?

d. What happens to the temperature if one-half of the gas is removed?

Practice Makes Perfect

A mixture of neon and argon gases exerts a total pressure of 2.39 atm. The partial pressure of the neon alone is 1.84 atm, what is the partial pressure of the argon?

0.55atm

A container contains a mixture of hydrogen, at a pressure of 2.00 atm, chlorine ,at a pressure of 3.10 atm, and oxygen at a pressure of 775.2mmHg, what percent is the pressure of chlorine?

16.7%

Home Work
5-Feb-2013

Complete B and C Gas Law Practice

on a separate sheet of paper showing all work using Word Problem Solving Box.

Due Thursday, 6 Feb 2014

Bell Work
6-Feb-2014

When a volume of 112L of hydrogen (5.0mols) is reacted with 2moles of oxygen, what is the remaining volume of hydrogen after the rxn? Assume Temperature and Pressure remain constant.

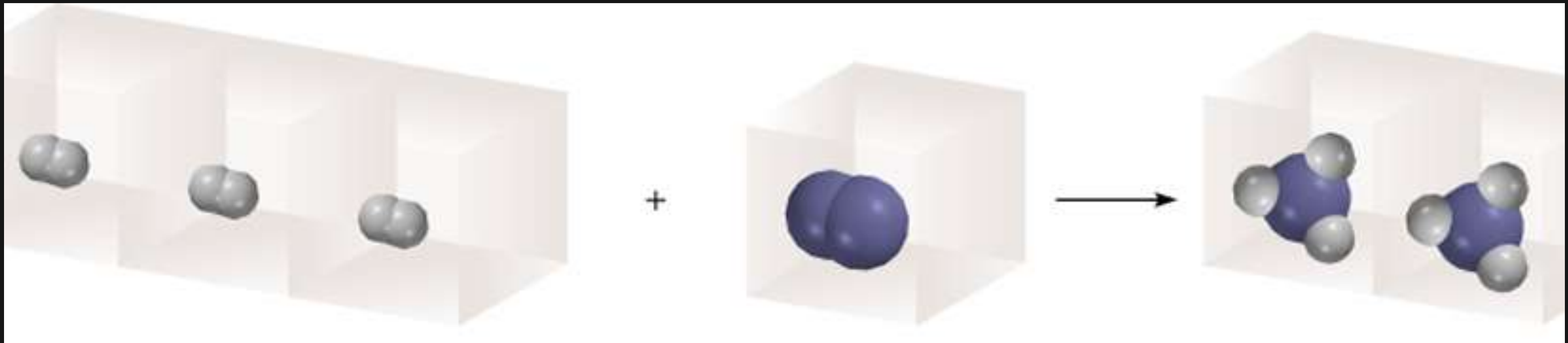
Avogadro's Law

$V \propto$ number of moles (n)

V = constant x n

Const. Temp.
Const. Pressure

$$\frac{V_1}{n_1} = \frac{V_2}{n_2}$$



$3H_2(g)$	+	$N_2(g)$	→	$2NH_3(g)$
3 molecules	+	1 molecule	→	2 molecules
3 moles	+	1 mole	→	2 moles
3 volumes	+	1 volume	→	2 volumes

Demo

Production of acetylene (L) gas moles α to moles reactants.

Try this…

Ammonia burns in oxygen to form nitric oxide (NO) and water vapor. How many volumes of NO are obtained from one volume (mole) of ammonia at the same temperature and pressure?

Ammonia burns in oxygen to form nitric oxide (NO) and water vapor. How many volumes of NO are obtained from one volume of ammonia at the same temperature and pressure?

$$4NH_3 + 5O_2 \longrightarrow 4NO + 6H_2O$$

$$1 \text{ mole } NH_3 \longrightarrow 1 \text{ mole } NO$$

At constant *T* and *P*

$$1 \text{ volume } NH_3 \longrightarrow 1 \text{ volume } NO$$

COMBINED GAS LAW

Boyles law: $P_1 \times V_1 = P_2 \times V_2$

Charles law: $V_1/T_1 = V_2/T_2$

$(V_1/T_1)\ P_1 \times V_1 = P_2 \times V_2 (V_2/T_2)$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

Practice

A 350 cm^3 sample of helium gas is collected at 22.0 ^oC and 99.3 kPa. What volume would this gas occupy at STP?

Practice

A 350 cm^3 sample of helium gas is collected at 22.0 ^oC and 99.3 kPa. What volume would this gas occupy at STP?

1. What you want? V_2 = ?	
2. Given Information V_1 = 0.350 L T_2 = 273K T_1 = 295K P_2 = 101.325kPa P_1 = 99.3kPa	4. Plan **V_2 =Solve For**
3. Useful formulas/ conversions **$P_1V_1/T_1 = P_2V_2/T_2$** **$V_2 = P_1V_1T_2/(T_1P_2)$**	5. Calculations for solutions $V_2 = \frac{(99.3kPa)(0.350\ L)(273K)}{(295K)(101.325kPa)}$ $V_2 = 0.317L$

Practice

A weather balloon is filled with helium to a volume of 31.5 L at 20^oC and 1.3 atm. In the stratosphere the temperature and pressure are -23^oC and 3.00×10^{-3} atm respectively. What will be the volume (in L) in the stratosphere?

Practice, again…

The gas inside of a flexible container at 25°C has a pressure of 0.25 atm. The size of the container starts out holding 3 L of gas. When it is heated to 30°C, its pressure is also increased to 0.27 atm. What happened to the volume of the container?

400 ml of a gas is contained at 300 mm Hg and 0^{o}C. What will its volume be in ml at 140 mm Hg and 10^{o}C?

Practice, again…

What must the final temperature be of a gas that was at 112 kPa at 20°C if the final pressure is 89 kPa? The gas is in a metal container that holds 2 L of gas.

You have oxygen gas in a balloon. At room temperature, 25°C, the balloon has a volume of 12L. You put the balloon in the freezer which is at 0°C. Calculate the final volume of the balloon. You can assume that at all times, the balloon is at atmospheric pressure.

BELL WORK
7-Feb-2014

The percent O_2 in a space ship's air is 21%. In A Space capsule the internal volume is $15m^3$. It operates at a temp of 22°C and a pressure of 760mmHg.

If a crack developed and the ship was rapidly exposed to spaces 0.001mmHg of pressure and -270°C temp what would the new volume be?

Agenda

Ideal Gas Law

Gas law Practice

Objective

You will KNOW the ideal gas law and how to solve for one of the four (4) variables when given the other three (3)

Warm up!

A sample of oxygen that occupies 1.00×10^6mL at 1 575 mmHg and temperature of 125 °C. What will the final volume of the sample be at STP?

Answer with your partner

Write down the combined gas law.

What would have to happen to temperature in order to cause volume/ pressure to decrease?

Ideal Gas Equation

Boyle's law: $V \alpha \frac{1}{P}$ (at const. *n* and *T*)

Charles' law: $V \alpha T$ (at const. *n* and *P*)

Avo's law: $V \alpha n$ (at const. *P* and *T*)

$$V \alpha \frac{nT}{P}$$

$$V = \text{constant} \times \frac{nT}{P} = R \frac{nT}{P}$$

R is the **gas constant**

$$PV = nRT$$

Standard Molar Volume: 1 mol = 22.4 L

At STP an ideal gas occupies a volume of 22.4 L/ mol.

So, what volume would 1.25 mole of H_2 gas occupy at STP

1.25mol H_2 x 22.4L/mol = 28 L

Using the conditions 0 ^{0}C and 1 atm called **Standard Temp. & Pressure (STP).**

Exp. show that at STP, 1 mol of an ideal gas occupies 22.4 L.

PV = nRT

$$R = \frac{PV}{nT} = \frac{(1\text{ atm})(22.4\text{L})}{(1\text{mol})(273\text{ K})}$$

***R* = 0.082057 L • atm / (mol • K)**

What is the volume (in liters) occupied by 49.8 g of HCl at STP?

1. What you want?	
2. Given Information $T = 0\ ^0C = 273\ K$ $P = 1\ atm$	**4. Plan** *Find mols HCl, Solve for V*
3. Useful formulas/ conversions $PV = nRT$ $V = \frac{nRT}{P}$	**5. Calculations for solutions** $n = 49.8g \times \frac{1\ mol\ HCl}{36.45\ g\ HCl} = 1.37\ mol$ $V = \frac{1.37 mol \times 0.0821 \frac{L \cdot atm}{mol \cdot K} \times 273\ K}{1\ atm}$ **$V = 30.6\ L$**

Practice… Ideal Gas

A 0.02 moles of oxygen gas is at 0.5 L at 0.25 atm. At what temperature (ºC) is the gas?

-197 ºC

A 334 mL gas cylinder contains 8.470 g (grams → mol) of helium at 23ºC. What is the pressure (atm) assuming ideal gas behavior?

154 atm

BELL WORK
10-Feb-2014

If Jiffy Pop cooking chamber reaches a volume of 2.2L at a temperature of 105°C and a pressure of 1.5atm, how many moles of water vaper are in the chamber?

(PV =nRT, R = 0.0821L atm/mol K)

Agenda

Ideal Gas Law and Stiochiometry.

Objective

You will KNOW how to use the ideal gas law to solve stiochiometry problems.

STOICHIOMETRY: RECAP

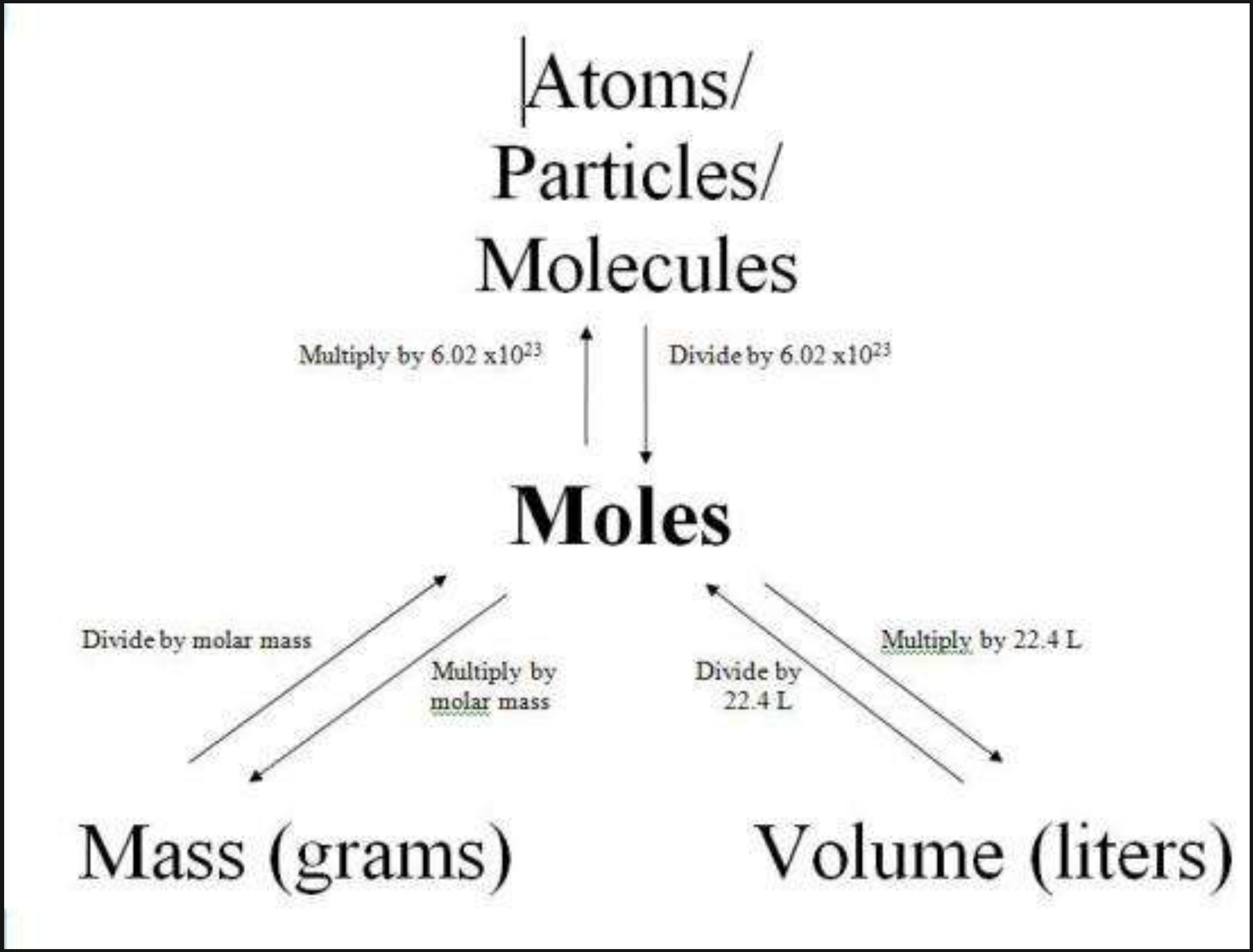
Grams A → (÷ mol mass)

moles A →(mol B/ mol A)

moles B → (x mol mass)

Grams of B

STOICHIOMETRY: RECAP

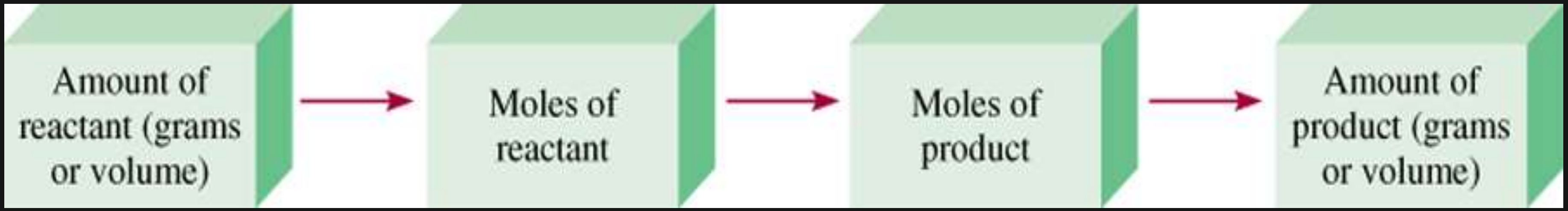


STOICHIOMETRY: RECAP

$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$

Using the following equation tell me how many grams of **H_2O** do I have if I reacted 4 grams of **O_2** w/ excess **NH_3**?

Gas Stoichiometry



What is the volume of CO_2 produced at 37 ºC and 1.00 atm when 5.60 g of glucose are used up in the rxn:

$C_6H_{12}O_6(s) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l)$

Gas Stoichiometry

What is the volume of CO_2 produced at 37^0 C and 1.00 atm when 5.60 g of glucose are used up in the reaction:

$$C_6H_{12}O_6\ (s) + 6O_2\ (g) \longrightarrow 6CO_2\ (g) + 6H_2O\ (l)$$

$$g\,C_6H_{12}O_6 \rightarrow mol\ C_6H_{12}O_6 \rightarrow mol\ CO_2 \rightarrow V\ CO_2$$

$$5.60\ \cancel{g\ C_6H_{12}O_6} \times \frac{1\ \cancel{mol\ C_6H_{12}O_6}}{180\ \cancel{g\ C_6H_{12}O_6}} \times \frac{6\ mol\ CO_2}{1\ \cancel{mol\ C_6H_{12}O_6}}$$

$$= 0.187\ mol\ CO_2$$

$$V = \frac{nRT}{P} = \frac{0.187\ \cancel{mol} \times 0.0821\ \frac{L \cdot \cancel{atm}}{\cancel{mol} \cdot \cancel{K}} \times 310\ \cancel{K}}{1.00\ \cancel{atm}}$$

$$= 4.76\ L$$

Try This

$C_6H_{12}O_6\ (s) + 6O_2\ (g) \rightarrow 6CO_2\ (g) + 6H_2O\ (g)$

Using the above balanced equation, if you combust 7.0 grams of glucose ($C_6H_{12}O_6$) what volume of H_2O do you end up with at STP (PV=nRT)?

Vapor Oxidation

What volume of CO_2 is produced from the combustion of 3.95g of ethanol (C_2H_3OH, assume STP and *do not* use 22.4L/mol)?

$2C_2H_3OH(g) + 5O_2(g) \rightarrow 4H_2O(l) + 4CO_2(g)$

Turn In
10 – Feb -2013

1. Gas Law Review #1

Home Work
10-Feb-2013

Gas Law Stiochiometry #1

1-4

Candle Can

How many moles of O_2 are used to produce the 3.0L of CO_2 at 400K and 5atm?

$\underline{1}CH_4\,(g) + \underline{2}O_2\,(g) \rightarrow \underline{2}H_2O(l) + \underline{1}CO_2\,(g)$

Bell Work
11-Feb-14

How many pop corn kernels are you going to use?

What should you not let the pop corn do when popping?

Agenda

"Pop Corn Lab"

Objective

You will KNOW how to use the ideal gas law to solve the water content of popping corn.

POPCORN and PV= nRT

Safety:

Vegetable oil is flammable. Heat the flask with care.

The flask must be securely fastened to the ring stand with a utility clamp.

Do not eat the popcorn!

POPCORN and PV= nRT

You will only be testing 1 of two (2) different brands of popping corns:

A or B.

Do not weigh any hot or warm flasks!

Complete a full pre lab write up and answer the pre lab Calculations

Bell Work
12-Feb-2014

$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(s) + H_2(g)$

a) According to the above balanced equations, If 3.0gof Zn are placed in an Erlynmer flask with excess HCl how many moles of H_2 gas should be formed?

b) If the gas is formed at STP what volume of gas should their be?

Agenda

Compound of the week

Ideal Gas Law, density, and Molar Mass.

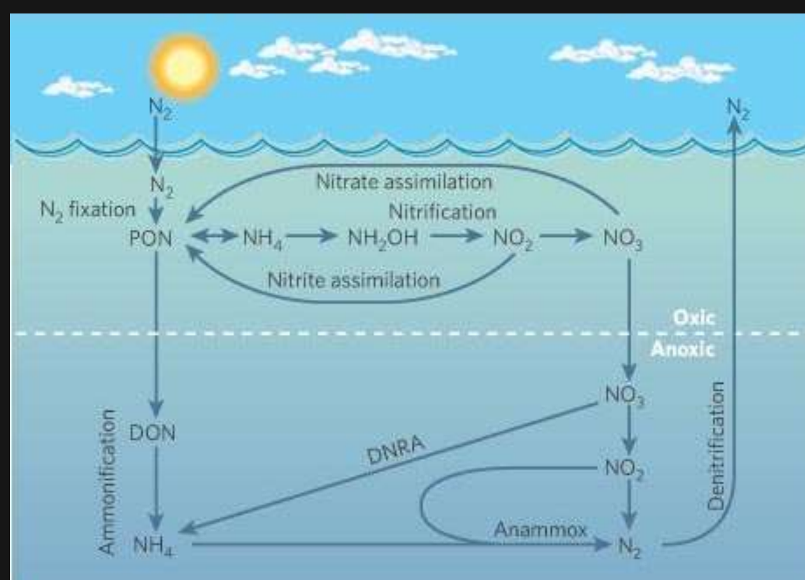
Objective

You will KNOW how to use the ideal gas law to solve density and Molar Mass problems.

Practice

What volume of nitrogen can be produced by the decomposition of 150.0 g of NH_4NO_2 at 125°C and 2.50atm?

(HINT: You must use correct temp and pressure units. And write a <u>balanced</u> equation. $NH_4NO_2 \rightarrow N_2 + H_2O$ **)**



Density and Molar Mass

Density (d) Calculations

$$d = \frac{m}{V} = \frac{P\mathcal{M}}{RT}$$

m is the mass of gas in g

$\mathcal{M}$ is the molar mass of gas

Molar Mass ($\mathcal{M}$) of a Gaseous Substance

$$\mathcal{M} = \frac{dRT}{P}$$

d is the density of the gas in g/L

And One more

Calculate the density of H_2S gas at 0.122 atm and 25.0°C

Practice…

What is the density of the following gases at 25ºC and 1 atm? CO_2,

$d = P\mathcal{M}/RT$

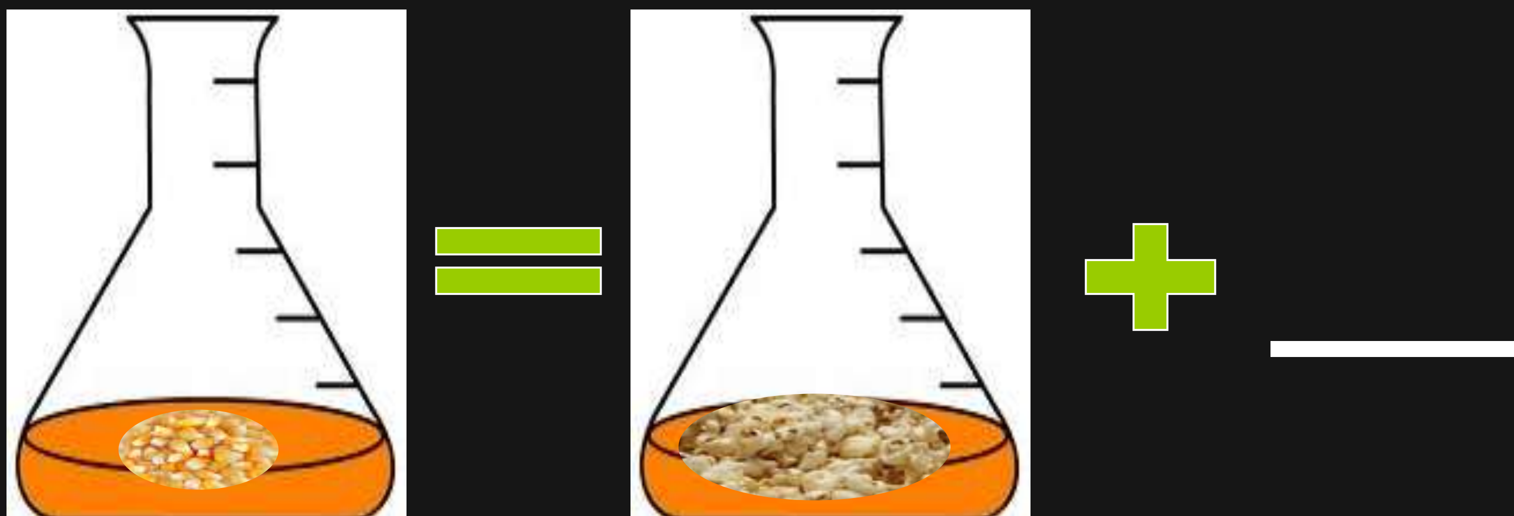
$\mathcal{M}_{CO2}$ = 44g/mol

$$d = \frac{(1\ \text{atm})(44\ \text{g/mol})}{(0.0821\ \text{L·atm/mol·K})(298\ \text{K})}$$

d = 1.80g/L

Now you try to find the density of H_2O at 25ºC and 1atm.

Pop Corn Lab



Homework
12-Feb-2014

Page 483 #6-9

Bell Work
14-Feb-14

15.00 g aluminum sulfide and 10.00 g water react until the limiting reagent is used up. Here is the balanced equation for the rxn:

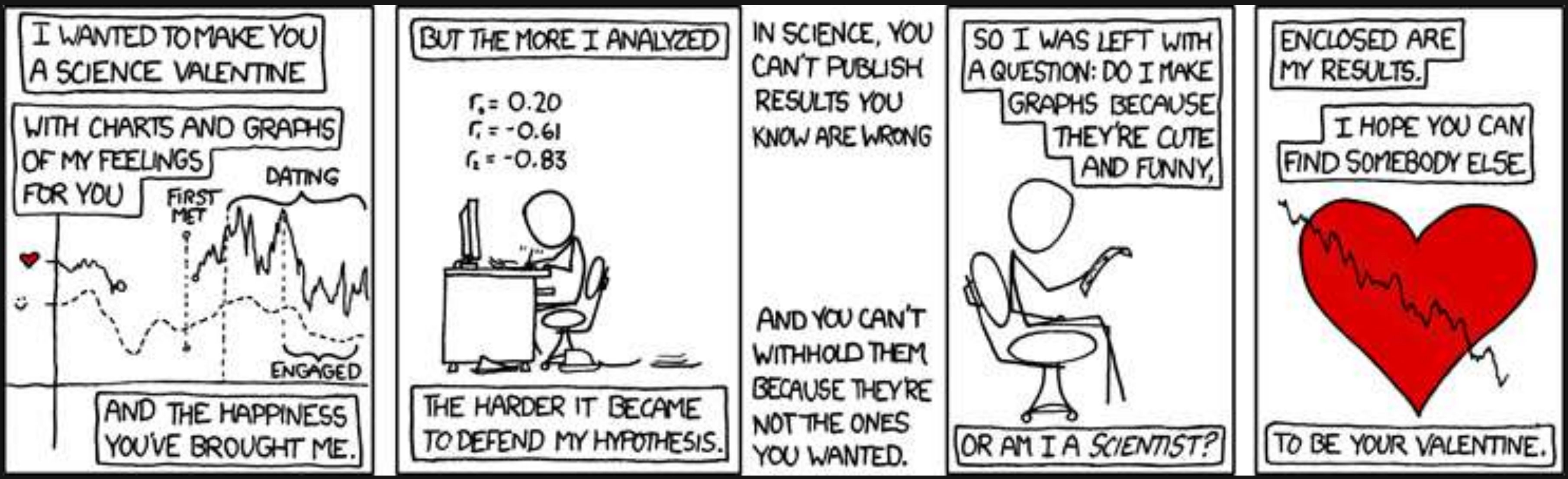
$$Al_2S_3 + 6\ H_2O \rightarrow 2Al(OH)_3 + 3\ H_2S$$

(A) Which is the limiting reagent?

(B) What is the maximum volume of H_2S gas which can be formed from these reagents at STP?

Valentines Day Card

Follow the instructions on the handout and complete the questions on the back, they need to be turned in before you leave today ☺



More Practice

Many gases are available for use in the laboratory in compressed gas cylinders, in which they are stored at high pressures. Let's calculate the mass of O_2 that can be stored at 21ºC and 170atm in a cylinder with a volume of 60.0 L.

Practice

How many grams of $AlCl_3$ must decompose in order to produce 2.0 L of Cl_2 at 45.0°C and 198.4 kPa?

(HINT: You must use correct temp and pressure units. And right a **balanced** equation. $AlCl_3 \rightarrow Al + Cl_2$)

Bell Work
17-Feb-14
New BW #2.4

The pressure in a 2.0 L container of C_4H_{10} is 1.5 x 10^{-4} torr at 1115K.

a. How many moles are in the container?

b. What is mass of the gas in the container?

Kinetic theory of gases and …

Compressibility of Gases

Boyle's Law

P α collision rate with wall

Collision rate α number density

Number density α $1/V$

P α $1/V$

Kinetic theory of gases and …

Compressibility of Gases

Charles' Law

$P \propto$ collision rate with wall

Collision rate $\propto$ average kinetic energy of gas molecules

Average kinetic energy $\propto T$

$P \propto T$

Kinetic theory of gases and …

Avogadro's Law

P α collision rate with wall

Collision rate α number density

Number density α *n*

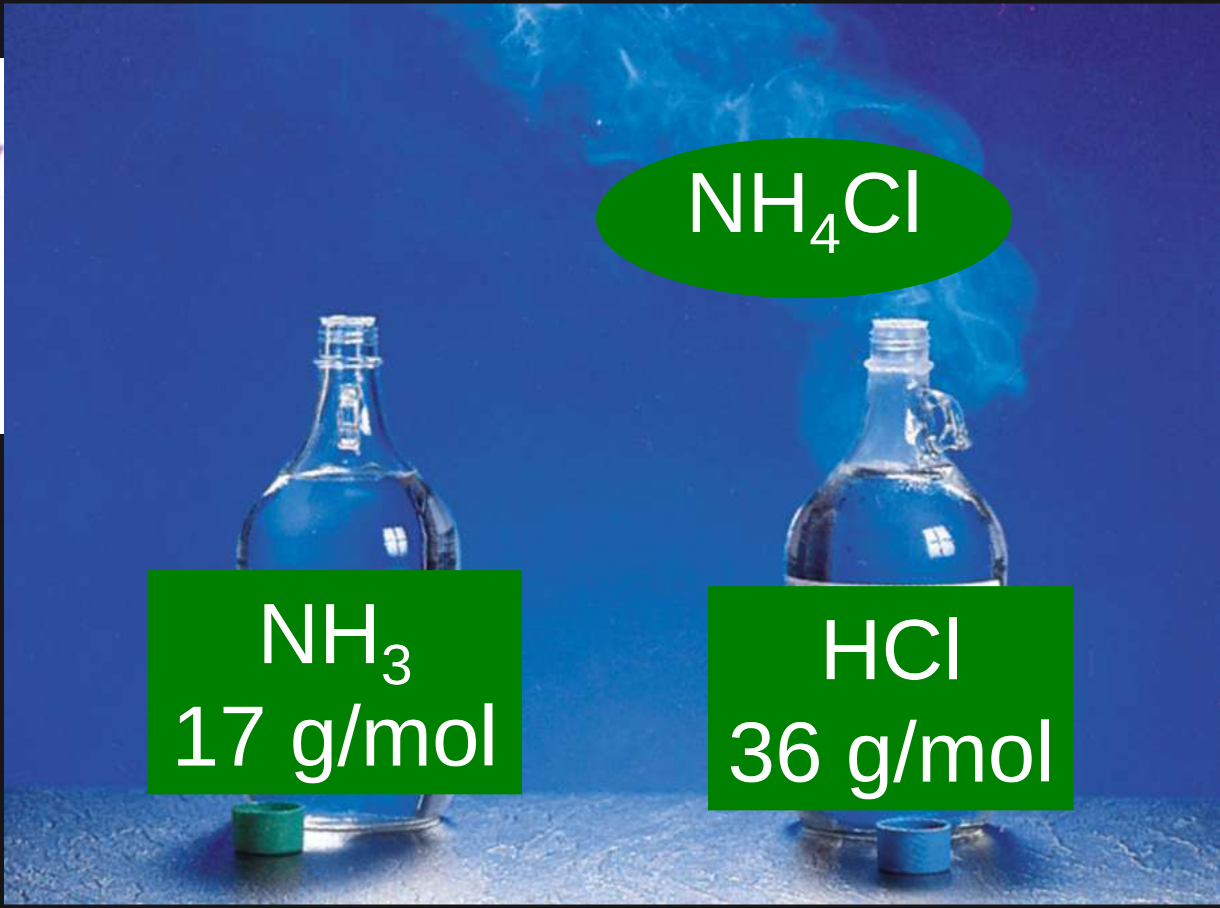
P α *n*

Kinetic theory of gases and …

Dalton's Law of Partial Pressures

- Molecules do not attract or repel one another
- P exerted by one type of molecule is unaffected by the presence of another gas
- $P_{\text{total}} = \Sigma P_i$

Gas diffusion is the gradual mixing of molecules of one gas with molecules of another by virtue of their kinetic properties.



A Little tougher

A 725 g sample of neon is introduced into a 4.5 L cylinder, and the cylinder is heated until the gas pressure is 375 atm. What is the gas temperature (in K) at this point?

The Goodyear blimp has 5.12×10^6 liters of helium at 25^{o}C and 1.00 atm. How many moles of helium are in the blimp?

Time to start calculating

If the molar mass of air is 28.97g/mol what is the density of the air in this class room? Assume the temperature is 22.5ºC and the pressure is 1003hPa (1atm = 1013.25hPa)

Time to start calculating

A: If the molar mass of air is 28.97g/mol what is the density of the air in this class room? Assume the temperature is 22.5ºC and the pressure is 1003hPa (1atm = 1013.25hPa)

$\mathcal{M}$ = 28.97g/mol

P = 1003hPa x 1atm/1013.25hPa → 0.99atm

T = 22.5ºC + 273 → 295.5K

R = 0.0821 L·atm/mol·K

$$d = \mathcal{M}P/RT$$

$$d = \frac{28.97\text{g/mol} \times 0.99\text{atm}}{0.0821\ \text{L·atm/mol·K} \times 295.5\text{K}}$$

1.18g/L

BELL WORK
18-Feb-2014

What is the density of nitrogen gas at a pressure of 2.3atm and a temperature of 282K?

$$d = \frac{P\mathcal{M}}{RT}$$

Agenda

Molar Mass Of Butane

Objective

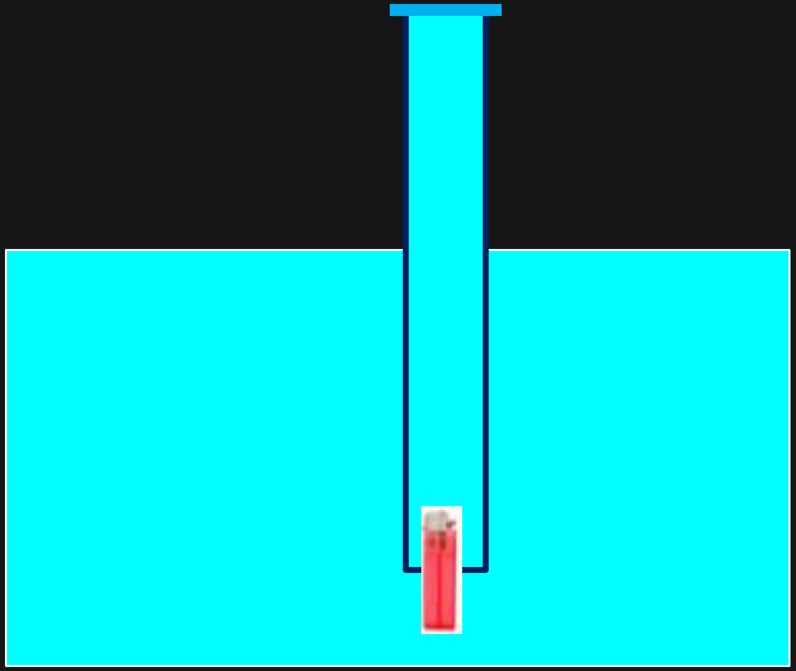
You will KNOW how to use the ideal gas law to solve the water content of popping corn.

Set Up

18-Feb-2014
Air pressure = 1014mbar
(1 mbar = 9.87×10^{-4} atm)

Pick a lighter and record mass to X.XX mg

Insure lighter is ***completely dry*** and do not depress gas plunger when drying



$$\mathcal{M} = \frac{dRT}{P}$$

d =

R =

T=

P_{C4H10}=

Test Time

Show all work on a separate sheet or paper.

You will turn in lab “Molar Mass of Butane” at end of Period